SINET Updates:
Report of Recent activities

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APAN48@Putrajaya, 25 July 2019
Agenda

• Link upgrades
  – Domestic links
    • Deployment plan of 400Gbps optical line
  – International links
    • Deployment of 100Gbps lines
    • Collaboration with other NRENs

• New services, experiment, etc.
  – LHCONE update
  – Data transfer experiment at TNC
  – Data mover challenge 2020
  – Wide-area data collection infrastructure update
History of SINET

1987: Predecessor of SINET (X.25 network) started operation

1992: **SINET** started operation as an Internet backbone (29 sites, 6～50Mbps)

2002: **Super SINET** (14 sites, 10Gbps)

2007: **SINET3** (34 prefectures, 1Gbps～40Gbps)

2011: **SINET4** (47 prefectures, 2.4Gbps～40Gbps)

2016: **SINET5** (47 prefectures, 100Gbps)

The maps illustrate the network connections and capacities over time, showing the expansion from 2.4Gbps～40Gbps to 100Gbps for all prefectures.
**SINET5**

- **SINET5** covers all the prefectures with 100-Gbps lines
  - Started its operation in April 2016.
- **SINET5** is used by 913 universities and research institutions, and by about 3 million users.

<table>
<thead>
<tr>
<th></th>
<th>National Universities</th>
<th>Municipal Universities</th>
<th>Private Universities</th>
<th>Junior Colleges</th>
<th>Colleges of Technology</th>
<th>Inter-Univ. Research Institutes</th>
<th>Labs and Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Organizations</td>
<td>86 (100%)</td>
<td>83 (93%)</td>
<td>398 (66%)</td>
<td>80 (25%)</td>
<td>56 (98%)</td>
<td>16 (100%)</td>
<td>194</td>
<td>913</td>
</tr>
</tbody>
</table>

(As of June. 2019)

- : SINET node
- : Domestic line (100Gbps or more)
- : International line (100Gbps)
- : Access line of user organization

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Plan: 400Gbps Optical Link Deployment

◆ Traffic amount between Tokyo and Osaka is becoming over 100Gbps.
  • By upgraded int’l links and ever-increasing traffic from existing applications.
◆ Standardization of 400Gbps optical transmission technology has been completed
  • Stable products will be available soon.
◆ Plan to introduce a new 400Gbps optical link between Tokyo and Osaka.

Operational in December 2019
400Gbps Optical Link between Tokyo and Osaka
Remarkable increase of traffic on 2x10G Tokyo-London link
International Line Upgrade in early 2019

- Japan-Europe line, Japan-New York + Amsterdam line (via Los Angeles), and Japan-Singapore line were upgraded to 100Gbps
International Line Upgrade (North Pole View)

- New 100-Gbps line
- Existing 100-Gbps line
- Other 100-Gbps line

Until March 2022
Resilient network connectivity

• Collaboration with other NRENs

• Mutual backup
  – Pacific area
    • Asia Pacific Ring (APR) Collaboration
      -> Already in operation
  – North Atlantic area
    • Advanced North Atlantic (ANA) Collaboration
      -> Just started !!
  – Asia-Europe area
    • AsiaPacific-Europe Ring (AER) Collaboration
      -> Just started !!
Asia Pacific Ring (APR) Collaboration started from Dec 2017.

- SingAREN, NICT, NII, Internet2, WIDE Project, Pacific Wave, and TransPAC

SINET 100Gbps JP-SG and JP-US (LA) links are a part of the APR Collaboration

Until March 2022
Advanced North Atlantic (ANA) Collaboration formed additional collaboration with SINET.

- Internet2, NORDUnet, SURFnet, CANARIE, GÉANT and SINET
- 100Gbps EU - US (AMS - NY) link is a part of the ANA Collaboration
ANA-300G + SINET Collaboration

Act as one L2 system

Montreal
New York
Washington

Amsterdam
London
Paris

Japan

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Asiapacific-Europe Ring (AER) collaboration.

- AARNet, GÉANT, NICT, NORDUnet, SingAREN, SURFnet, TEIN*CC, and SINET
- 100Gbps JP-Asia (Tokyo – Singapore) link is a part of the AER Collaboration
- Signed in Putrajaya, Singapore, on 22 July 2019

In March 2019

Until March 2022
Asiapacific-Europe 100G Collaboration
International Collaboration (North Pole View)

- **ANA**: New 100-Gbps line
- **AER**: Existing 100-Gbps line
- **APR**: Other 100-Gbps line

Until March 2022

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  – Data transfer experiment at TNC
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  – Wide-area data collection infrastructure update
LHCONE peering configuration (-2018)

Supported by JGN since Oct. 2017
LHCONE peering configuration (2019)

Supported by JGN since Oct. 2017
• An experiment with MMCFTP at TNC19@Estonia (19/June/2019).

• Transferred between Japan and Estonia over 4x100G network

• **321Gbps** data transfer rate.

• Used 4 lines [Tokyo – Amsterdam] via:
  • (SINET direct)
  • Seattle – Chicago - Montreal
  • Los Angels – New York
  • Singapore – London
Contribution to Data Mover Challenge (DMC)

DMC Network Topology as of 2019/07/05
Wide-Area Data Collection Infrastructure

- Mobile capability for IoT research and mobile-oriented applications toward 5G era.
- Mobile virtual network is directly combined with SINET
  - Creates secure L2VPNs for research groups.
- Analytic platforms provided by cooperative vendors as well as commercial clouds and universities' computers are connected to SINET.
Research Themes proposed in Mobile Service Testbed

- Mobile service testbed started on December 21st, 2018.
- 39 original and creative research themes have been proposed from a wide range of fields.

Agriculture, forestry
- Cattle management
- Sake/tea making process support
- ICT farming management
- Agricultural growth environment
- Fruit production
- Energy saving plant factory

Natural environment
- Weather and tsunami forecast
- Disaster data delivery
- Building earthquake resistance
- Regional disaster prevention support
- Environment/disaster prevention
- Sato-yama environmental preservation
- Natural environment monitor
- Wind power operation

Medical / Life Sciences
- Brain information
- Biological data
- Medical information remote viewing
- Disaster medical support
- Smart Treatment room

Social system
- Remote learning
- Virtual education
- Teaching research support
- Remote monitoring
- Human motion analysis
- Athlete competence support
- Outdoor robot control
- Labor management
- Mobility data utilization
- Wide area AR system
- Traffic data aggregation

Information infrastructure
- Virtual data platform
- Virtual research environment
- Multipoint campus communication
- Distributed analysis environment evaluation
- Evaluation of mobile transparency
- Distributed Computing environment
- Motion picture real time AI processing
- Time synchronization information transfer
- Mobile edge computing
We expect that 5G technology as an effective means to access SINET.

- Plan to introduce 5G-NR in 2020.

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**5G Introduction Scenario**

- **Drastic performance improvement**
- **Continuous evolution**
- **Phase 1**
  - 10-Gbps class broadband using high frequency band (4.5 / 28 GHz)
  - Ultra low latency and massive simultaneous connections
- **Phase 2**
  - eLTE (enhanced LTE)
    - Same frequency band as LTE for compatibility
    - Only several times speeding up and hard to reduce delay drastically

**Systems Performance**

- **LTE-Advanced**
  - 3GPP Rel.10~14
  - Rel.15

- **4G**
  - 3.9G
  - Rel.16

- **5G**
  - NR (New Radio)
  - Rel.15
  - Rel.16

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Thank you for your attention!